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Phytoecology of the Atlas Pistachio (*Pistacia Atlantica* sub sp. *Atlantica*) in the Area of Laghouat (Algeria)

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***Abstract*:** The present work aims to study the floristic and ecological formations of *Pistacia atlantica* in the dayas of the wilaya of Laghouat phytoecological approach. One of the essential characteristics of the vegetation of this area is great plant diversity. The pistachio tree of the Atlas (*Pistacia atlantica*) is a very hardy xerophilous tree with great amplitude vis-à-vis the climatic factors not affected by the long periods of drought. The floristic inventory carried out has allowed us to identify 45 taxa, divided into 24 families and 40 genera. Systematically, the Asteraceae and Poaceae are the best represented, 20% of the floristic richness. The biological analysis shows the importance and predominance of therophytes on the other forms, this predominance is characteristic of the vegetation of arid regions which are adapted to the Saharan and steppe environment. From the biogeographic analysis, it emerges the predominance of the Mediterranean element. The numerical analysis, by the use of the analysis of the relaxed correspondences (DCA) and the ascending hierarchical classification (CHA), allowed us to individualize two floristic sets as well as the ecological factors which govern their distribution.

***Keywords*:** Laghouat*, Pistacia atlantica* formation, Numerical analysis, Ecology, Phytodiversity

The pistachio tree of the Atlas presents many interests at the ecological level as a protector of the pastoral steppe, soil preserver and air conditioner. Due very powerful root system, it can participate in the fixation of soils. Leaves constitute a good fodder for the feeding of the livestock. These trees as have nutritional values that can be used as fodder for ruminants. For several decades the natural resources of the steppe space (soil, water, vegetation) have suffered severe degradation due to the combined effects of an increasing human and animal pressure and an aggravating drought on these ecosystems (Bouderbala 2012) . The study of the vegetation concerns the description of the groups and their stationary conditions. The day as of Laghouat are characterized by tree vegetation represented by the Pistachio of the Atlas, a shrub vegetation represented by the wild Jujubier and a herbaceous vegetation.

The climate through its various factors (temperature, rainfall, wind) plays a determining role and intervenes in a decisive way on the growth and distribution of plants (Dahmani 2011). The temporal variation of monthly rainfall shows that the total rainfall is very irregular from one month to another. In Laghouat, the driest month is represented by July (5.6 mm) and the rainiest month is September with 22.8 mm. Temperature is a limiting factor of primary importance, as it conditions the distribution of species and communities of living beings in the biosphere (Ramade 1984). In Laghouat the coldest months are December, January and February, with minimum temperatures below 4°C. The hottest are June, July and August, with maximum temperatures ranging from 35.44 to 39.23°C. The average maximum temperature reaches 39.23°C in July, the hottest month. On the other hand, in January, the coldest month, the average minimum temperature is 2.15°C. In the region of Laghouat, Salemkour et al (2013) had collected 66 species in the stations of El Houaita, Sidi Bouzid and Gueltet Sidi Saad. These authors made a comparative study of the floristic characteristics between free rangelands. This work on *Pistacia atlantica* is part of the preservation and conservation of this tree and to present the state of the flora of this important pastoral region (Laghouat), in order to appreciate its phytodiversity, as a model of highland area.

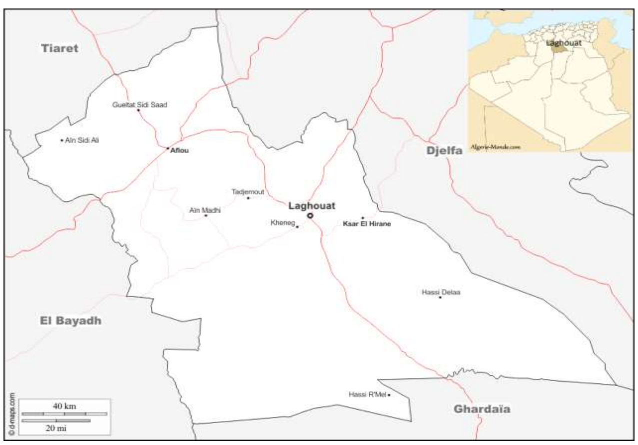
MATERIAL AND METHODS

Study region: Due to its geographical position and climatic characteristics, the wilaya of Laghouat is part of the pastoral wilayas of the country, as well as the wilayas of the South (ANDI 2013).Laghouat, a former oasis, became chief town of wilaya in the administrative division of 1974(Benblidia et al 2006) .With an area of 25052 km², the wilaya of Laghouat is located 400 km as the crow flies in the south of Algeria of the Mediterranean coast (Aniref 2013). It is bounded to the north, by the wilaya of Tiaret, to the east, by the wilaya of Djelfa, to the south, by the wilaya of Ghardaïa, to the west, by the wilaya of El Bayadh (Fig. 1).

Prospecting methods: Several field missions were organized in the different zones of Laghouat. The study of vegetation and natural environment are defined by several types of sampling, the one chosen for our study is the subjective sampling (Braun-Blanquetand De Bolos 1957). The surveys are carried out in physiognomically homogeneous areas. The floristic surveys were carried out on 100 m^2 plots.

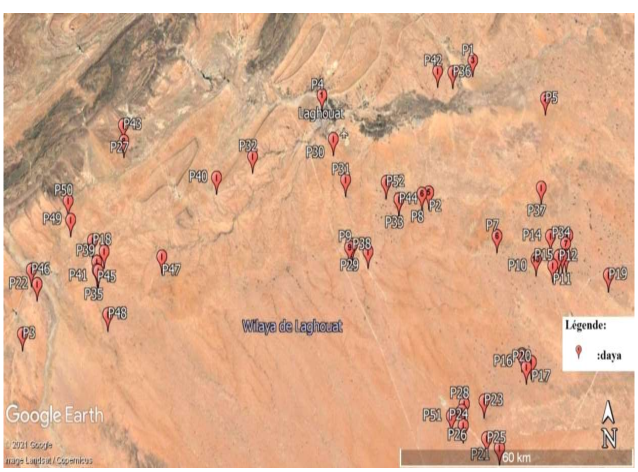
The surface of 100 m^2 seems sufficiently representative of the minimum area in our study area (Benabadji and Bouazza 2002, Hasnaoui et al 2011). The sampling work was distributed in the field at the 52 sites. The coordinates of each site were noted using a GPS receiver. The 52 sites surveyed are located in the municipalities of Hassi Delaa, Ksar El Hiran, Kheneg, Ben Nacer Ben Chohra,Hassi R'mel,Ain El Madhi,Tadjrouna,Laghouat, Aflou and El Houita (Table 1, Fig. 2).

Data analysis: The numerical processing consists of factorial correspondence analysis (FCA) and detached correspondence analysis (DCA), followed by hierarchical ascending classification (HAC).



Source: d-maps.com

Fig. 1. Geographical location of the wilaya of Laghouat



Source: Photo taken on Google Earth

Fig. 2. Location of floristic surveys conducted in the Laghouat area

RESULTS AND DISCUSSION

The evaluation of the flora of Laghouat, was based on three main parameters: the biological, taxonomic and biogeographical diversity of the pre-Saharan and steppe ecosystems within the groups of *P. atlantica*. The flora encountered in the 52 dayas of Laghouat presents a diffuse spatial distribution, considering the surface, but very diversified: 45 species belonging to 40 genera and 24 families. Salemkour et al (2013) in the regions of El-Houaita, Sidi Bouzid and Gueltet Sidi Saad (wilaya of Laghouat) observed 66 species belonging to 21 families. Mallem et al (2017) collected in the region of Mokrane (wilaya of Laghouat) 30 species belonging to 29 genera and 14 families.The floristic richness is variable according to the different dayas, the highest is observed in the dayas of Tilghimt(Ayyat and Smahi). It is low in the dayas of Ajal, Saadia and Bouzidi with 03, 04 and 05 species. The flora of Laghouat reveals an unequal distribution of species between families: 06 families share alone more than 57% of species, while 18 families share the remaining 43%, where most are represented by only one taxon. Poaceae and Asteraceae contain 20% each and are the best represented. Malvaceae, Borraginaceae, Zygophyllaceae and Plantaginaceae contain 4.44% each. The other families Geraniaceae, Euphorbiaceae, Polygonaceae, Rutaceae, Lamiaceae, Brassicaceae, Capparidaceae, Convolvulaceae, Papaveraceae, Orobanchaceae, Cistaceae, Thymelaeaceae, Oxilidaceae, Caryophyllaceae and Apiaceae with 2.22% each (Fig. 3). This floristic diversity is related to the diversity of climates, geomorphology, nature of soils and anthropic action (Benaradj et al 2012). The Asteraceae family is the most dominant in the dayas with 09 species identified Poaceae are also well present on the wilaya's rangelands with a group of 8 species. Among the Fabaceae, the 2 species inventoried are *Astragalus armatus, Medicago polymorpha*, among the Malvaceae inventoried (*Malva parviflora, Malva aegyptica*) and Zygophyllaceae (*Fagonia glutinosa, Peganum harmala*) (Table 2).

The dayas of the communes of Hassi Rmel and Ksar El Hirane are the richest compared to other communes knowing that these dayas are plowed for a long time, which has favored the development of annual plants such as *Rumex vesicarius, Papaver rhoeas, Medicago polymorpha, Matricaria recutita* and *Avena sterilis* and perennials such as *Triticum repens, Malva parviflora, Echium humile, Ruta chalepensis* and *Reichardia tingitana*, namely the dayas of Tilghimt, Belil, Soltane, Boulehya, Zatacha, Baguira 1 and

Table 1. Location of the day as where the samples are taken

No. of the daya	Daya's name	Longitude	Latitude	Municipalitie
P4	Magrounat	33°28'54.30"N	3°30'57.36"E	Hassi Delaa
P5	Raysa	33°28'54.30"N	3°30'57.36"E	Hassi Delaa
P1	Kayed	33°32'15.17"N	3°33'46.87"E	Ksar El hiran
P6	Mansoura	33°37'12.48"N	3°10'5.80"E	Hassi Delaa
P2	khaled	33°32'15.04"N	3°21'36.13"E	Ksar El hiran
P7	Ben terbeh	33°37'4.40"N	3° 8'54.54"E	Hassi Delaa
P8	Saadi	33°31'20.77"N	3°33'19.54"E	Hassi Delaa
P34	Oum rzaime	(33°43'9.04"N	2°17'23.16"E	Kheneg
P27	Timzghit	33°31'6.99"N	2°56'23.93"E	Ben nacer ben chohra
P9	Bouezara	33°29'39.12"N	3°28'8.92"E	Hassi Delaa
P10	Magrounat 2	33°28'54.30"N	3°30'57.40"E	Hassi Delaa
P11	Marfouaa	33°29'55.70"N	3°32'2.82"E	Hassi Delaa
P12	Bouti	33°29'58.00"N	3°33'18.70"E	Hassi Delaa
P13	Abdelkader Bouchoucha	33°32'11.62"N	3°30'46.37"E	Hassi Delaa
P14	Hairech	33°29'59.36"N	3°32'39.59"E	Hassi Delaa
P15	Hneya	33°19'13.27"N	3°25'7.97"E	Hassi Delaa
P16	Hejaj	33°18'22.82"N	3°26'40.55"E	Hassi Delaa
P17	Bounoua	33°17'52.33"N	3°25'48.92"E	Hassi Delaa
P20	Tilghimt	33° 9'17.57"N	3°20'53.33"E	Hassi R'mel
P21	Belil	33°13'59.71"N	3°15'15.19"E	Hassi R'mel
P28	Smahi	33°30'37.07"N	2°59'32.01"E	Ben nacer ben chohra
P29	Ayyat	33°31'23.08"N	2°56'52.42"E	Ben nacer ben chohra
P38	Boumousi	33°30'41.19"N	2°14'35.57"E	Ain Madhi
P39	Legrar 1	33°28'31.47"N	2°13'42.39"E	Ain Madhi
P35	Lihoudi	33°38'59.19"N	2°33'33.40"E	Kheneg
P40	Gouffa	33°29'31.30"N	2°13'23.91"E	Ain Madhi
P41	Legrar 2	33°28'3.35"N	2°13'31.63"E	Ain Madhi
P45	Lelmaya 1	33°28'36.59"N	2° 2'16.23"E	Tadjrouna
P46	Lelmaya 2	33°27'1.88"N	2° 3'21.99"E	Tadjrouna
P22	Soltan	33°14'18.58"N	3°18'34.00"E	Hassi R'mel
P23	Boulehya	33°11'42.87"N	3°14'59.57"E	Hassi R'mel
P24	Zatacha	33°10'19.23"N	3°18'49.27"E	Hassi R'mel
P25	Baguira 1	33°13'14.83"N	3°14'49.37"E	Hassi R'mel
P26	Baguira 2	33°12'43.45"N	3°13'5.11"E	Hassi R'mel
P51	Gatte	33°43'22.43"N	2°53'43.49"E	Laghouat
P30	Talmzane	33°38'42.53"N	2°55'47.89"E	Ben nacer ben chohra
P31	Tinsafine	33°38'25.43"N	3° 2'46.46"E	Ben nacer ben chohra
P52	sidi bouzid	34°11'42.77"N	2°10'10.97"E	Aflou
P37	Rass mabzoug	33°30'7.74"N	2°24'27.27"E	El Houita
P47	Dakhla	33°21'34.87"N	2° 1'16.04"E	Tadjrouna
P3	Kebala	33°51'13.94"N	3°12'8.67"E	Ksar El hiran
p42	Saadia	33°45'0.09"N	2°17'11.43"E	Ain Madhi
P43	Ajal	33°51'4.58"N	3°14'47.60"E	Ain Madhi
P36	Bouzidi	33°41'23.93"N	2°39'44.71"E	Kheneg
P32	Latrech	33°36'19.91"N	3° 1'54.05"E	Ben nacer ben chohra
P33	Bsibisa	33°36'27.30"N	3° 4'55.44"E	Ben nacer ben chohra
P44	Lakhal	33°23'45.76"N	2°15'34.44"E	Ain Madhi
P48	Terkalal	33°34'11.39"N	2° 8'39.76"E	Tadjrouna
P49	Hotaiba	33°36'20.55"N	2° 8'5.60"E	Tadjrouna
P50	Boukhalkhal	33°31'53.53"N	2°12'32.33"E	Tadjrouna
P18	Terfas	33°27'47.31"N	3°40'24.63"E	Hassi Delaa
P19	Bouziane	33°27'47.31"N	3°40'24.63"E	Hassi Delaa

Baguira 2 for the municipality of Hassi Rmel and the dayas of Kayed, Khaled and Kebala for the municipality of Ksar El Hirane. Some dayas in the commune of Hassi Rmel and Ben Nacer Ben Chohra in Laghouat, have been cleared and cultivated with barley (*Hordeum vulgare*), such as Tilghimt, Smahi Zatacha while others in the same communes have been cultivated with soft wheat (*Triticum aestivum*) such as Ayyat, Belil and Boulehya. The problem of the cultivation of cereals in some dayas, which has an impact on the flora, ploughing and harvesting of cereals or note destruction of the natural vegetation in favor of agricultural spaces in the funds of dayas. Indeed, the extension of ploughing and the strong pressure with more and more systematic use of agricultural machines, within the dayas causes a clearing and a systematic eradication of the perennial species. Kaabèche (2003) observed that the use of the plough not only causes the disappearance of all plant cover but also destroys the soiland leads to the "physical" destruction of the rangeland. There are dayas that are well protected by the population and forestry services, such as that of Lelmaya (commune of Tadjrouna, wilaya of Laghouat) where the main plant cover is *Sonchus arvensis*. The jujube tree is present in all the dayas with the exception of some in the commune of Hassi Rmel such as Belil and soltane. According to the biological type, the species are divided into 21 therophytes, 14 hemicryptophytes, 07 chamephytes, 02 geophytes and 01 phanerophyte (Fig. 4). These eigenvalues quantify the amount of information contained in the data matrix and are therefore a first-order aid in determining the number of axes to be retained. For the present analysis, because of the gap between axis 2 and 3, only the first two axes will be retained for the analysis of the survey and species sets. The eigenvalues obtained from the AFC are close to those of the DCA (0.35 for the first axis and 0.32 for the second axis), but the individualization of the different ecological groups is

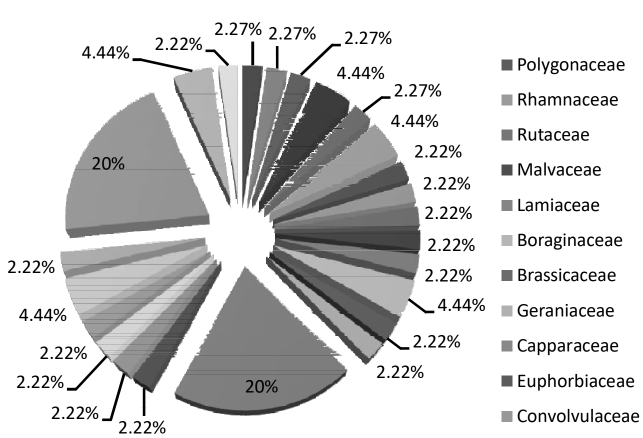


Fig. 3. Main families of the flora of the 52 day as of Laghouat

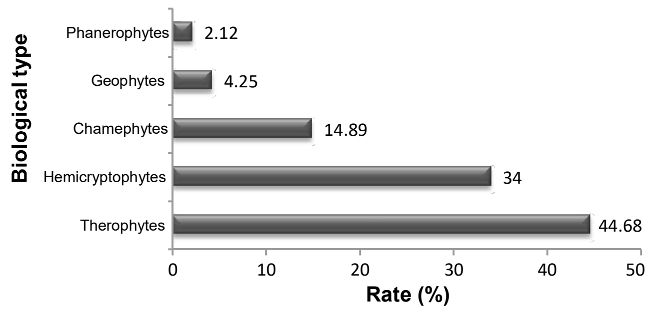


Fig. 4. Biological spectrum of the inventoried species

Table 2. Species identified in the study area

Family	Species
Asteraceae	*Matricaria recutita, Launaearesedifolia, Leontodon saxatilis, Onopordum macracanthum, Podospermum laciniatum, Reichardia tingitana, Silybum marianum, Santolina africana , Sonchus arvensis*
Poaceae	*Triticum repens, Triticum aestivum, Avena sterilis, Hordeum murinum, Cymbopogon schoenanthus, Stipa tenacissima, Cynodon dactylon, stipagrostis obtusa, Hordeum vulgare*
Fabaceae	*Astragalus armatus, Medicago polymorpha,*
Malvaceae	*Malva parviflora, Malva aegyptica*
Zygophyllaceae	*Fagonia glutinosa, Peganum harmala*
Boraginaceae	*Echium horridum, Echium humile*
Plantaginaceae	*Plantago ciliata , Plantago logopus*
Rutaceae	*Ruta chalepensis*
Lamiaceae	*Salvia verbenaca*
Brassicaceae	*Ammosperma cinereum*
Capparaceae	*Cleome arabica*
Convolvulaceae	*Convolvulus arvensis*
Papaveraceae	*Papaver rhoeas*
Orobanchaceae	*Orobanche cernua*
Rhamnaceae	*Ziziphus lotus*
Geraniaceae	*Erodium triangulare*
Euphorbiaceae	*Euphorbia calyptrata*
Cistaceae	*Hélianthemum lippii*
Oxilidaceae	*Oxalis corniculata*
Chenopodiaceae	*Arthrophytum scoparium*
Caryophyllaceae	*Paronychia argentea*
Apiaceae	*Pimpinella anisum*
Polygonaceae	*Rumex vescarius*

much clearer with the DCA. It is for this reason have opted for the latter to interpret results.

The climate has a dominant influence on the life of plants, both by rainfall and by temperature and light (Dahmani 2011). According to the rainfall gradient, Mediterranean and endemic elements decrease slightly with aridity, while the Saharan-Arabic and Mediteranean-Saharan-Arabic increase significantly. The water factor, associated with the thickness of the soil exploitable by plant roots, plays an essential role in the floristic composition and distribution of plants in the different habitats. Indeed, whatever the type of habitat, this factor acts by compensating the aridity of the climate and thus allows the maintenance of a relatively rich flora.

Three combined actions best explain the establishment of the flora, climatic changes, long-distance transport by wind and birds, and changes in geographic distribution. Finally, this study shows the importance of phytogeography, which allows us to study the phytodynamics. But also contributes to the knowledge of the impact of climatic and anthropic changes on ecosystems.

Detrended correspondence analysis and factor analysis of correspondence: The results of the DCA provide the eigenvalues for the first three axes (Table 3).

Ecological and floristic characterization of the identified groups: The characterization of the identified clusters is done by superimposing the factorial map of surveys (Fig. 6) and the species map (Fig. 7). In addition, the use of ecological and floristic information collected in the field allows us to describe the two sets of surveys obtained on the first

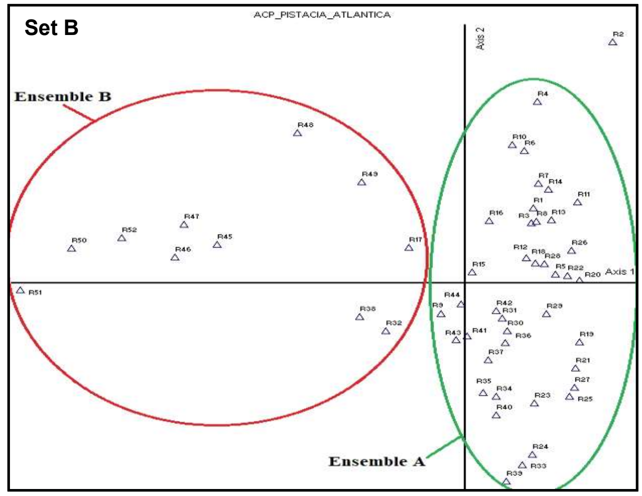


Fig. 6. Map of surveys on the ½ factorial plane of the DCA

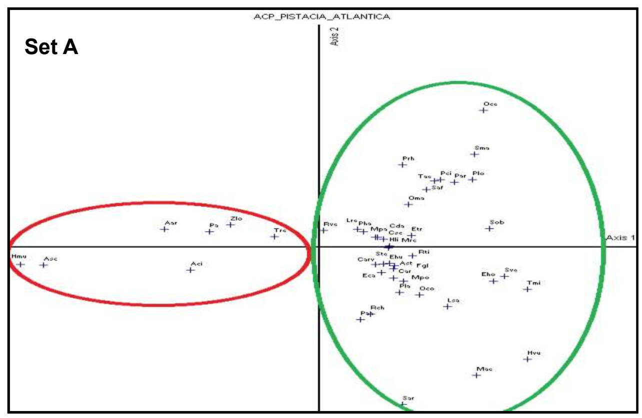


Fig. 7. Species on the factorial plane ½ of the DCA Ecological significance of the factorial axes

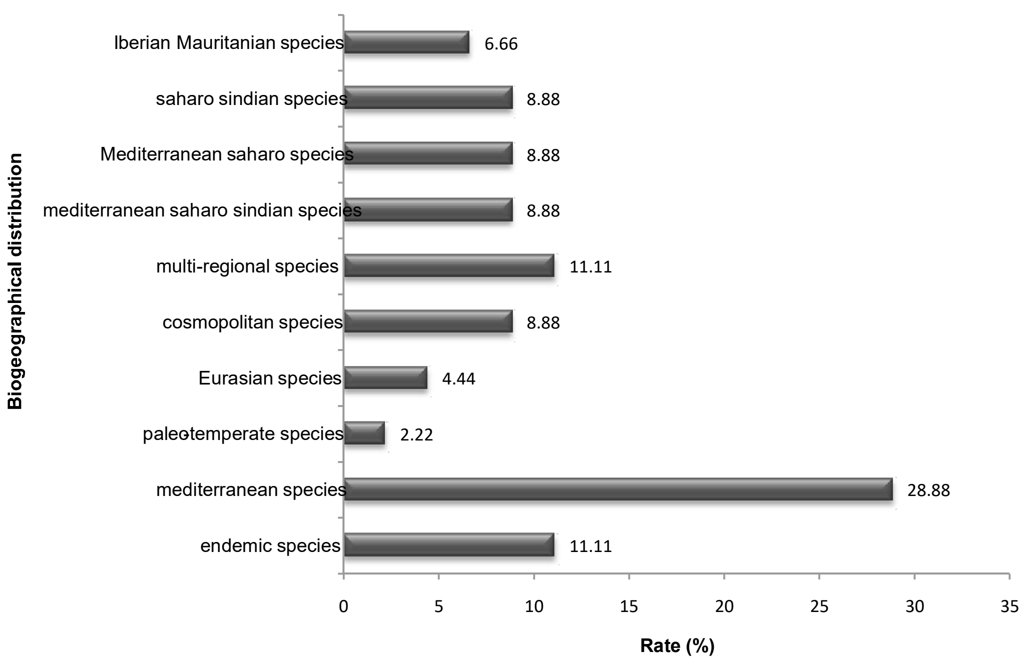


Fig. 5. Biogeographical distribution of collected taxa

factorial map. The individualization of the survey groups was carried out on the factorial map represented by axis 1 and 2.

Set A: Occupies the negative part of axis 1 represents the driest dayas. It contains 13 surveys: R9, R15, R17, R32, R36, R45, R46, R47, R48, R49, R50, R51 and R52 at an average elevation of 800 m on sandy-clay substrate characterized by a higher sand content compared to the surveys on the positive side. The overall vegetation cover varies from 5 to 10%. Physiognomically, this group is characterized by *Arthrophytum scoparium* and *Ammosperma cinereum*. There is also a good development of *Hammada scoparia* and *Ziziphus lotus*, which are well represented in this group. Although at low frequency, we note the presence of *Triticum repens.*

Set B: Occupies the positive part of axis 1. It contains 39 records: R1, R2, R3, R4, R5, R6, R7, R8, R10, R11, R12, R13, R14, R16, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R33, R34, R35, R37, R38, R39, R40, R41, R42, R43 and R44. This set is represented by the surveys conducted under *Pistacia atlantica*. The 39 surveys carried out at an average altitude of 900 m on a clayey-sandy substrate. The global cover of the vegetation varies from 10 to 15 %. Physionomically an environment subject to anthropic action, including overgrazing, plowing and cultivation of cereals, which has allowed the development of ruderal species such as *Hordeum murinum, Hordeum vulgare* and *Triticum aestivum* as well as psamophilous species, elective of sandy sail such as Euphorbia calyptrate (Mallem et al 2017). The positive side includes grazing species that mostly grow on more or less encrusted surfaces, such as Erodium triangulare which is a grazing indicator therophyte, as well as *Malva eagyptiaca* and *Stipa parviflora* (Salemkour et al 2013) .

The ecological interpretation is often delicate because each axis can integrate several factors in different proportions. The highlighting of ecological factors acting on the distribution of the vegetation is based on the autoecology of the species, on the one hand, and on the stationary data collected in the surveys on the other hand. The species and the surveys taken into consideration are those whose relative contributions are the highest.

Axis 1 denotes the water stress and also the floristic richness which is important (positive part of axis 1) is reduced (negative part of axis 1). The presence of relatively water and fertility demanding species such as *Avena sterilis, Santolina africana* and *Schismus barbatus* was observed (Mallem et al 2017). Opposing the less water and soil fertility demanding species, well adapted to the arid conditions of these biotope types, such as: phanerophytes *Pistacia atlantica* and +3. accompanied by: *Plantago ciliata,Euphorbia calyptrata, Medicago polymorpha* and *Rumex vescarius* (Bouderbala 2012).

This group is marked by the dominance of species: *Pistacia atlantica, Ziziphus lotus* but the total number of species is reduced. These pistachio dayas have a high vegetation cover at 60-75%, an average litter rate hardly exceeding 20%.

The second axis is very clearly represented by a lithological gradient. It allows to classify the least degraded dayas (Tilghimt, Belil soltane, Boulehya, Zatacha, Baguira 1 and Baguira 2 for the municipality of Hassi Rmel and the dayas of Kayed, Khaled and Kebala for the municipality of Ksar El Hirane) in its positive part and those degraded (Daya lihoudi, saadia, ajal and bouzidi of the commune of Ain El Madhi) in the negative part, and confirms that a gradient of anthropic disturbance that allows to classify the dayas and corresponds to the determining factor in the distribution of grouping to *Pistacia atlantica*. The anthropic action is apparent through the presence of species of grazing, *Peganum harmala* testifies to the pressure of overgrazing and the postcultural character of these dayas, *Malva parviflora* known as ruderal and overgrazing. On the positive side, are grouped species for the most part therophytes that seem *Launaea resedifolia, Rumex vesicarius,* etc. and develop in arid bioclimate (Saharan). This richness in therophytes is linked to an occasional humidity.

On plan F1/F2, *Pistacia atlantica* contribution is high (7.35) and closer to the species *Ziziphus lotus* (4, 38). The 2 species are positioned closer in the same side, which explains that the regeneration of *Pistacia atlantica* occurs most often only in the shelter of the clump of *Z. lotus* (Monjauze 1968, Amara 2014, Benaradj 2010), so *P. atlantica* is sheltered in these clumps in order to protect the new plants from animals and strong winds. This association called *P. atlanticae* limited by two species: a tree layer (*P. atlantica*) and a shrub layer (*Z. lotus*). This regeneration is generally done within clumps of *Z. lotus* (Rhamnaceae) which protects the young shoots of the Atlas Pistachio from grazing, and promotes the germination of its seeds and the growth of its young shoots by enriching the soil in organic matter (Yaaqobi et al 2009). Kaabèche (2005) observed remarkable phenomenon called "facilitation" is to be pointed out about this species: this term "facilitation", gathers any

Table 3. Eigenvalues of the first three axes of the DCA

Axes	Eigenvalues
Axis 1	0,345
Axis 2	0,256
Axis 3	0,183

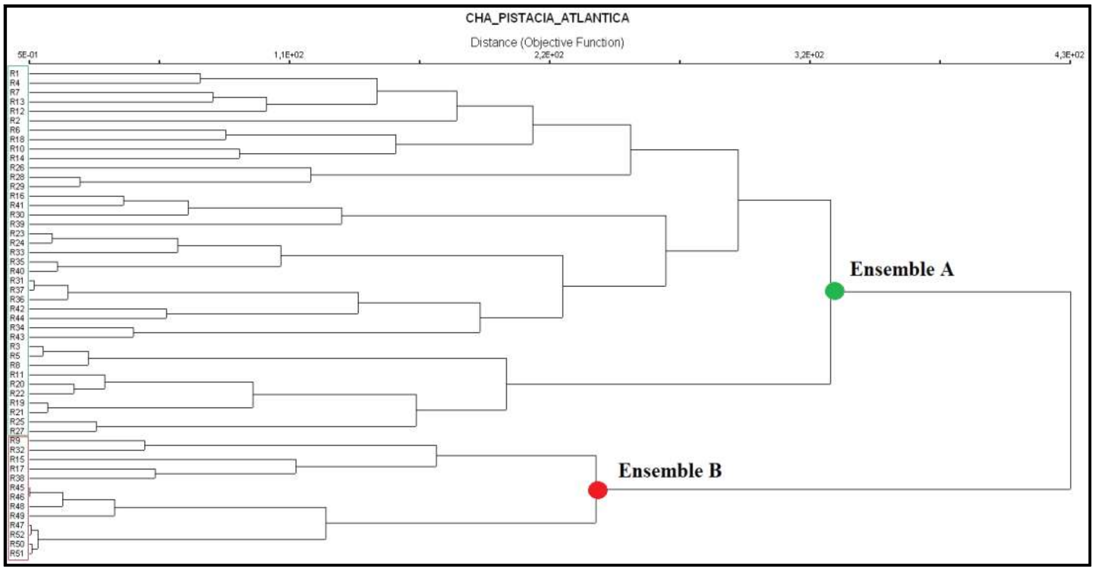


Fig. 8. Dendrogram of the hierarchical bottom-up classification of the total matrix

situation where a plant favors the establishment and the development of another plant thanks to privileged interspecific relations.

Hierarchical ascending classification: The CHA is the complement of a factorial analysis. It consists of grouping the individuals in a data set by similarity and thus allows for the confirmation of the results obtained previously with the DCA (Fig. 8). The 2 sets highlighted are thus delimited and confirm the results obtained by the DCA.

The CHA dendrogram shows two large clusters (A and B), which corroborates the results obtained during the numerical analysis, and confirms that geomorphology corresponds to the determining factor in the distribution of our *P. atlantica* ssp. atlantica grouping. Figure 9 represents the schematic distribution of the cores in the axes. The analysis has allowed a clear division of the floristic groups into floristically and ecologically homogeneous. Two groups (A and B) were highlighted and are thus delimited.

Group A: It is characterized by *Arthrophytum scoparium* and *Ammosperma cinereum*, we also note a good development of *Hammada scoparia*, and *Ziziphus lotus* well represented within this group.

Group B: represents the mosaic between the different biological types (phanerophytes, chaméphytes, Hemicryptophytes, Geophytes), with a remarkable wealth of therophytic species, among these species we distinguish: *Euphorbia calyptrata, Medicago polymorpha, Erodium triangulare, Reichardia tingitana, Pimpinella anisum*, etc.

CONCLUSION

The herbaceous vegetation and biomass of the selected *Pistacia atlantica* dayas varied significantly, which allowed us to appreciate the different adaptation strategies of the living organism. The predominance of therophytes is characteristic of the vegetation of arid regions that adapt to the Saharan and steppe environment. The predominance of the Mediterranean element confirms the Mediterranean affinity of the flora of the region. The extension of ploughing and the introduction of mechanization are parameters of degradation as important as overgrazing is retained as the main factor responsible for the floristic variations, it is imperative and urgent to create a strict protection zone specific to this species; otherwise, it risks to disappear in a very near future. To improve this form of protection, a balance between human activities and the natural dynamics of this species is necessary; in order to promote a continuity between the different strata: herbaceous, chamaephytes and phanerophytes. Also in the natural protection of Pistacia atlantica, by the creation of plant belts by species not consumed by livestock as *Ziziphus lotus* (L.) Desf*. Hammada scoparia*, and *Thymelaea microphylla*.

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